Accepted Manuscript

Development and validation of an integrated planetary gear set permanent magnet electric motor power loss model

Charles Nutakor, Juho Montonen, Janne Nerg, Janne Heikkinen, Jussi Sopanen, Juha Pyrhönen

PII: S0301-679X(18)30171-3

DOI: 10.1016/j.triboint.2018.03.026

Reference: JTRI 5170

To appear in: *Tribology International*

Received Date: 29 January 2018

Revised Date: 19 March 2018

Accepted Date: 23 March 2018

Please cite this article as: Nutakor C, Montonen J, Nerg J, Heikkinen J, Sopanen J, Pyrhönen J, Development and validation of an integrated planetary gear set permanent magnet electric motor power loss model, *Tribology International* (2018), doi: 10.1016/j.triboint.2018.03.026.

Development and Validation of an Integrated Planetary Gear Set Permanent Magnet Electric Motor Power Loss Model

Charles Nutakor, Juho Montonen, Janne Nerg, Janne Heikkinen, Jussi Sopanen, Juha Pyrhönen

Lappeenranta University of Technology, Skinnarilankatu 34, 53850 Lappeenranta, Finland

Abstract

This study proposes a methodology to predict power losses of traction motor having an integrated planetary gear set permanent magnet electric motor, including both load-dependent and load-independent power loss components. The methodology combines a planetary gear set loss model which accounts for sliding and rolling losses at the external and internal gear mesh contact interfaces, a bearing mechanical and drag loss model, a gear drag loss model, an external and internal gear mesh pocketing loss model, a permanent magnet synchronous machine iron, and copper loss model. Power loss measurements from a developed prototype traction motor having integrated planetary gear set permanent magnet electric motor is compared to model predictions to successfully demonstrate the accuracy of the proposed methodology.

Keywords: Integrated gear drive, Load-dependent power loss, Load-independent power loss, permanent magnet electric motor power loss